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Performance criteria for a personalized indoor environment

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1. Introduction

During the last decade several systems for providing a high quality personal indoor environment have been studied and tested. Also several products/systems are now available on the market. The existing standards with criteria for the indoor environment (thermal, air quality, noise , light) are all based on criteria for the whole occupied zone (ISO EN 7730, EN15251, ASHRAE-55, ASHRAE-62.1). Can these criteria be directly applied also to a personal system, where the occupants try to meet their own preferences? If the occupants have a personalized system is it then possible to relax on the requirements to the general environment? These are some of the issues that will be discussed in the paper. Based on the many studies found in the literature on personalized systems for control of thermal comfort, air quality, lighting and noise a set of criteria for the personalized environment will be established. At the same time recommended changes in the existing criteria for the general environment will be made.

2. Materials/Methods

Personalized indoor environmental systems can provide the occupant with an individual control of thermal comfort, perceived air quality, illumination and noise control. In general for illumination and noise you can use the same criteria for a personalized environment like for a general environment. Most personalized systems blowing air towards the occupant (Figure 1)

Figure 1: Typical set-up of personalized ventilation system.

This set-up will mainly influence the perceived air quality and an increased cooling due to an increased air velocity and may be lower air temperature of the supply air. As shown in Figure 2 a personalized system may divide the space in two zones. One close at the occupants and a general zone. The question is if it should be allowed to relax the indoor environmental criteria for

Figure 2: The occupied zone will be divided in two zones

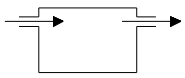
the general zone if a personalized system is available.

3. Results

The analysis shows that due to the large individual differences in the preferred indoor environment among occupants a personalized environment will increase the acceptance, comfort and performance of people (Melikov, 2004). Studies (Kaczmarczyk et. Al. 2004) show that the occupants accepted a higher air velocity than in an open space with general ventilation. This is taken care of in existing standards, where increased air velocity is acceptable when under individual control. This means a personalized system must have individual control of the air velocity.

The increased ventilation effectiveness should allow a decrease of the supply ventilation rate. This can be taken into account by correcting the required ventilation rates in the standard tables (based on complete mixing) with the ventilation effectiveness as indicated in Figure 3.

Figure 3: Ventilation Effectiveness for different combinations of supply-return positions and temperature differences between supply and room air temperature.

Mixing ventilation		Mixing ventilation		Displacement ventilation		Personalized ventilation	
							
T supply - T inhal °C	Vent. effect. -	T supply - T inhal °C	Vent. effect. -	T supply - T inhal °C	Vent. effect. -	T supply - T room °C	Vent. effect. -
< 0	0,9 - 1,0	< -5	0,9	<0	1,2 - 1,4	-6	1,2 - 2,2
0 - 2	0,9	-5 - 0	0,9 - 1,0	0-2	0,7 - 0,9	-3	1,3 - 2,3
2 - 5	0,8	> 0	1	>2	0,2 - 0,7	0	1,6 - 3,5
> 5	0,4 - 0,7						

It also shows that the design of the systems requires a broader range of temperatures, velocities, ventilation levels, etc. than the normal range use for an average occupant. These systems may however also lead to energy savings because a more efficient use of for example ventilation and a relaxation of the requirements to the surrounding general environment.

4.Conclusions/Recommendations/ Discussion.

With the increasing number of products on the market for personalized environmental control, there is a need to establish design and performance criteria. These performance requirements must be specified for the zone near the occupant. For the general environment the requirements must be relaxed compared to existing standards. Finally there is a need for a testing procedure to verify the resulting ventilation effectiveness.

5. References

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